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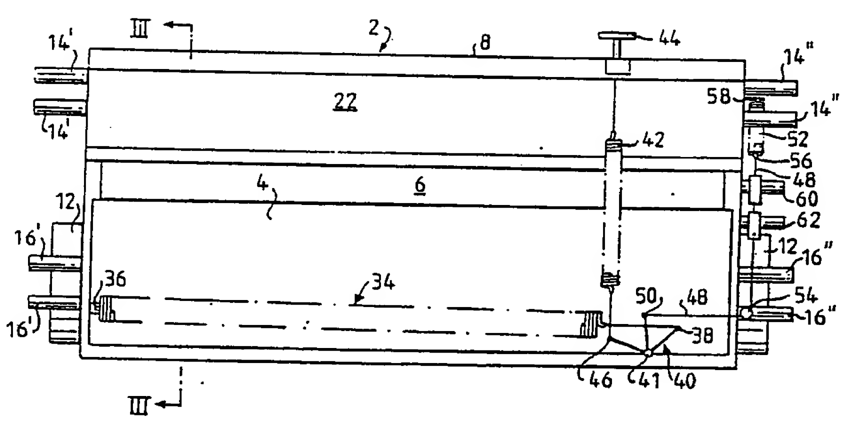
(54) Title: DAMPER-REGULATING ARRANGEMENT FOR INDUCTION APPARATUS WITH COOLING AND HEATING BATTERIES



(57) Abstract

Damper-regulator for a ventilation air supplying induction apparatus (2) having cooling and heating batteries, the ventilation air being introduced interiorly of the apparatus thereby co-ejecting room air, which then flows from the room into the apparatus casing (4) and which can pass through either battery. On one apparatus casing side an air-temperature-sensing memory metal-spring (34) is provided having one end secured to the casing and the other to a first point (38) of a leverage (40) rotatably mounted on the casing, said leverage furthermore being acted upon by a counterforce spring (42) between the casing and a second leverage point (46). A regulating wire (48) extends between a third leverage point (50) and a return spring (52) secured to the apparatus casing. When the wire (48) moves, control means (72, 74) secured thereon can act upon spindles (60, 62) of dampers (28, 30) controlling the passage of co-ejected room air through either battery or through an inlet duct (26) not leading to any battery.

Damper-regulating arrangement for induction apparatus with cooling and heating batteries

The present invention relates to a damper-regulating arrangement for an apparatus provided with cooling and heating batteries, especially an induction apparatus, by means of which preprocessed primary air, such as ventilation air, is supplied to an enclosed locality or room in which the apparatus is located. The primary air is supplied at a relatively high velocity at the interior of the apparatus and, in the course of this process, co-ejects secondary air in the form of room air, which is permitted to flow into the casing of the apparatus from the enclosed locality and can, during this process, be caused to pass through the cooling or heating battery in order to be cooled or heated.

An induction apparatus of the general type here concerned is primarily intended to be used as a facade or surface apparatus (window apparatus) for supplying air at a facade wall. Such a surface apparatus is used for ventilation and heating or cooling, respectively, of air-conditioned premises such as offices. To this end, it is necessary for the apparatus to supply, on the one hand, preprocessed primary air (ventilation air), while, on the other hand, being capable of bringing about preprocessing of the room air in the enclosed locality by causing it to flow through the apparatus so that, as a result, it is heated or cooled as it passes through the heating or cooling battery in the apparatus.

Primary air is introduced therefore at relatively high velocity at the interior of the apparatus, the flow of primary air being also used to induce, by co-ejection, a flow of room air (secondary air) into and through the

apparatus for reprocessing by heating or cooling. The newly supplied ventilation air is thus mixed with co-ejected room air in the apparatus and then blown out of the apparatus through one or several openings, which are normally arranged in the upper side of the apparatus casing.

The need to reprocess room air (by heating or cooling) varies of course in accordance with, inter alia, the heat generated in the enclosed locality/room, the degree of ventilation, solar radiation in the enclosed locality, ambient air temperature etc.

It must therefore be possible to regulate heating or cooling of the room air as it flows through the apparatus. With induction apparatus of the kind beforementioned, this is achieved by providing in the enclosed locality a room thermostat which senses the prevailing temperature of the room air and causes the regulating equipment of the apparatus, which with the aid of damper-controlled electric motors regulates the damper arrangement by which the room air can be guided through the heating or cooling battery in the apparatus, to be controlled in respect of a required set-point value. This electrical regulating equipment presupposes therefore an electric current supply and is, in addition, relatively complicated and expensive, and it also necessitates wiring. Another disadvantage consists in the fact that the electrical regulating equipment, in particular the servomotors, do not operate noiselessly, but often produce irritating buzzing or humming sounds in the course of switching the dampers.

Accordingly, the prime object of the present invention consists in providing for the kind of induction apparatus intended a technically uncomplicated and therewith inexpensive purely mechanical damper-regulating arrangement

of a new kind which can replace the above-mentioned known electrical regulating equipment.

According to the invention, this is achieved by attachment, on a side of the apparatus accessible to the room air, of an air-temperature-sensing memory metal-spring, one end of which is secured to the casing of the apparatus and the other end of which is secured to a first point of a lever device which is rotatably mounted on the casing of the apparatus and which, in addition, is acted upon by, on the one hand, a counterforce spring attached between the casing of the apparatus and another point of the lever device and, on the other hand, a regulating wire extending between a third point on the lever device and one end of a return spring, the other end of which is secured to the casing of the apparatus, and in that attached to the regulating wire are control means which, when the wire moves, can act on damper spindles pertaining to dampers which serve to control the passage of the co-ejected room air through the apparatus, either via one of the batteries for cooling or heating and/or through an inlet duct in which the flow of room air does not pass through any of the batteries.

By means of a damper-regulating arrangement of this construction an installation is achieved which is simpler throughout (without electrical components and wiring), which virtually does not require any care or any maintenance, which is more reliable in operation (no danger of non-operation due to power failures) and which operates in an entirely noiseless manner.

The memory metal-spring may, for instance, be made from an alloy consisting predominantly of brass (copper and zinc) and contains, in addition, a few per cent of aluminium. The purpose of the counter-force spring is to maintain the

bias of the memory metal-spring within its entire given operating range, in order to avoid undesirable hysteresis in the operating curve of the memory metal-spring (i.e. a curve showing how the length of the spring changes as a function of the spring material's temperature). By changing the biassing force exerted by the counterforce spring it is also possible to displace the operating curve of the metal storage-spring in the temperaturelength variation diagram.

The return spring has the function of providing the force necessary for resetting the damper.

A memory metal-spring is a spring which "remembers" the form that it had at a certain temperature. When returned to this temperature, the memory metal-spring requires its original form. The memory metal-spring is advantageously a helical spring constituting a tension spring mounted at the front side of the casing of the apparatus facing towards the interior of the enclosed locality/room. Since the memory metal-spring is designed as a tension spring, it is not necessary to provide appropriate lateral guides for such spring, which would otherwise be necessary if the spring were a compression spring.

Different aspects of preferred embodiments of the inventive damper-regulating arrangement are set forth in the following independent claims.

Claim 3, for instance, discloses that the memory metal-spring and the counterforce spring are advantageously arranged with a parallel-epipedic apparatus casing.

Claim 5 discloses a suitable comfort-dependent temperature range in respect of the memory storage interval of the

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Fig. 4 shows the air flow with max. heating, and Fig. 5 shows the apparatus in its neutral state, in which the co-ejected room air is neither cooled nor heated.

Induction apparatus 2 shown in Figs. 1 and 2 is constructed as a facade or surface apparatus for attachment to a wall in the room in which the apparatus is mounted. The basic principle is that the ventilation requirements of the room are met by supplying preprocessed primary air through the apparatus 2 or, when the need is found, several such apparatus connected in series. The induction apparatus also ensures that secondary air in the form of room air, which is co-ejected owing to the supply of primary air, is reprocessed by cooling or heating in the apparatus. Hence the apparatus is provided with two built-in plate batteries, one for cooling and one for heating.

As can be seen from Figs. 1 and 2, the induction apparatus 2 comprises a substantially parallelepipedic casing 4 in the front side of which facing the inside of the room there is an oblong air inlet 6 for room air, and in the upper side 8 of which there is an equally oblong air outlet 10 for the primary air and the co-ejected room air.

The induction apparatus 2, which with the embodiment shown is assumed to be connected in series with several units of the same type, has on its end faces primary-air connectors 12 in the form of circular duct sections, tubular connectors 14' and 14" for feeding and discharging the water for a cooling battery 18 in the top of the apparatus, and tubular connectors 16' and 16" for feeding and discharging the water for a heating battery 20 located in the bottom of the apparatus. Room air which is to be cooled flows into the cooling battery 18 through an opening 22 located in the front side of casing 4, whereas air intended to flow through heating battery 20 enters the apparatus

through a lower air inlet 24 (see Figs. 3-5). When the room air flowing into the apparatus is neither cooled nor heated, it enters casing 4 of the apparatus through the air inlet 6 and the inlet duct 26 located within said inlet, said duct in the neutral position shown in Fig. 5 extending into the apparatus between two rotatably switchable dampers 28 and 30, the positions of which are controlled by means of the damper-regulating arrangement according to the invention. In Figs. 3-5 the flow arrows R indicate room air flowing into apparatus 2, whereas the flow arrows P within the interior of the apparatus casing 4 indicate the introduction of primary air, at relatively high velocity, through small nozzles 32. As a result of this influx of primary air, secondary air in the form of room air R is induced, said air being capable of flowing through the battery 18 or 20 or through the inlet duct 26.

We now go on to a more detailed study of the damper-regulating arrangement according to the present invention, said regulating arrangement being a purely mechanical arrangement replacing previously known regulating arrangements with electric motors for controlling and switching the dampers 28 and 30. The components forming part of the damper-regulating arrangement can be seen in Figs. 1 and 2.

At the front of the apparatus casing 4, which is freely accessible to room air, there is attached a memory metal-spring 34 in the form of a helical tension spring, which responds to, and as a result senses, the air temperature prevailing at the bottom of the front side of the apparatus. The left-hand end of the memory metal-spring 34 (as seen in Fig. 1) is attached (at 36) to casing 4 of the apparatus, whereas the other end of spring 34 (on the right in Fig. 1) is attached to a first point 38 of a lever device 40 rotatably located at 41 on the apparatus casing. Although the lever device is shown in Fig. 1 in

the form of a three-armed linkage, it could equally well be a roller or a disc where the engagement points of the levers, such as points 38, constitute mutually separate attachment points. Apart from the tensile force exerted by memory metal-spring 34, the lever device 40 is also in part acted upon by a counterforce spring 42 attached between a temperature-setting knob 44 at the top of casing 4 of the apparatus and another point 46 on the lever device 40. The lever device is also subject to the force exerted by a regulating wire 48, which extends between a third point 50 on the lever device 40 and one end of a return spring 52 arranged within the right-hand end face of the apparatus casing 4 (as seen in Fig. 1). Regulating wire 48 extends from point 50 on the lever device 40 to the counterforce spring 52 via a deflector roll 54 located at the right-hand end face of the apparatus casing 4. The end of the regulating wire 48 located at said end face is secured to the lower end of the return spring 52 at 56. The upper end of the return spring 52 is secured to the apparatus casing 4 in a holder 58 at the right-hand end face of the casing.

The two rotatable switchable dampers 28 and 30, whereof damper 28 permits flow of the room air through the cooling battery 18 while damper 30 permits flow of the room air through the heating battery 20, are each secured on its respective damper spindle 60 or 62, these spindles being rotatably journalled in the two end faces of the apparatus casing 4. So as to enable switching of the dampers, the damper spindles 60 and 62 extend, at one end face of the casing, through the corresponding wall of the casing, as can be seen at the right-hand side of the casing in Fig. 1. So as to prevent the regulating forces required for switching the dampers from becoming excessively large, the damper-spindle ends projecting from the casing 4 are provided with damper-balancing weights 64 and 66.

Furthermore, each damper spindle 60 and 62 has attached thereto a respective lever 68 or 70 which projects towards the regulating wire 48, said regulating wire 48 either passing through said lever or said lever having actuating parts located immediately adjacent the wire 48.

The wire 48 has attached thereto in the region above the lever 68 and below the lever 70, control means 72 and 74, which, when the regulating wire 48 moves (for instance, in consequence of a temperature-related change in the length of memory metal spring 34) are brought into contact with the appropriate damper-spindle lever, in order to cause thereby the spindle concerned to rotate and thus to switch the damper secured to the spindle.

As indicated above, the memory metal-spring 34 will accordingly sense the temperature of the room air upstream of the induction apparatus 2, and when this temperature changes, the length of the memory metal-spring 34 will also change in consequence thereof, this change in length being transmitted to the regulating wire 48 via the lever device 40, which with the embodiment shown consists in a three-armed linkage in which the regulating wire 48 is connected to point 50 at the end of the central lever.

In order finally to explain the operation of the damper-regulating arrangement, it is assumed that the memory metal-spring is so constructed as to ensure that a lowering of the room air temperature sensed by the spring will result in lengthening of the memory metal-spring.

With such lowering of the temperature, the regulating wire 48 will then move to the right in Fig. 1, i.e. upward at the right-hand end face of the apparatus casing 4. In the course of this process, the control device 74 is caused to contact the lever 70 of damper spindle 62, and as the wire

48 continues to move upward (in Fig. 2), the damper spindle 62 will therefore turn clockwise in Fig. 2, i.e. anticlockwise in Figs. 3-5, as a result of which the damper 30 is gradually swung up towards a more open position enabling passage of the room air through the heating battery 20. Consequently, the damper 30 is switched from the position shown in Fig. 5 to the maximum opening position shown in Fig. 4, which causes maximum heating of the room air passing through the apparatus. This causes heating of the volume of air in the room concerned, which in turn brings about a gradual rise of the air temperature in the vicinity of the memory metal-spring 34, thus causing the length of the memory metal-spring to be reduced and, accordingly, causing the regulating wire 48 to move to the left in Fig. 1 and, therefore, downward in Fig. 2. This causes the damper 30 to be gradually closed from the position shown in Fig. 4 to the position shown in Fig. 5, and if the temperature of the room air now continues to be higher than the required temperature, the control device 72 will gradually come into contact with the lever 68 of the damper spindle 60, which if the wire 48 continues to move downward initiates counter-clockwise rotation of the spindle 60 in Fig. 2, i.e. clockwise rotation in Figs. 3-5. This leads to a gradual opening of the damper 28 from the position shown in Fig. 5 to the position shown in Fig. 3, in which room air flows in through the cooling battery 18 and causes, accordingly, maximum cooling of the room air sucked into the apparatus through co-ejection. Cooling of the room air sucked in continues thereafter until the memory metal-spring 34 senses that the temperature of the room air has dropped and, as a result, increases its length, which in turn gradually leads to throttling of the flow of room air through the cooling battery and switching of the damper 28 to the neutral position shown in Fig. 5, in which the room air flowing through air inlet 6 and the inlet duct 26 is neither cooled nor heated.

CLAIMS

1. Damper-regulating arrangement for an apparatus (2) provided with cooling and heating batteries (18, 20), especially induction apparatus, whereby preprocessed primary air (P), such as ventilation air, is supplied to an enclosed locality or a room in which the apparatus is located, whereby said primary air is supplied at relatively high velocity at the interior of the apparatus and, during this process, co-ejects secondary air in the form of room air (R), which is caused to flow from the enclosed locality into the casing (4) of the apparatus and can, during this process, be caused to pass through said cooling or heating battery in order to be cooled or heated, characterized in that, on one side of the apparatus casing (4) which is accessible to room air, there is mounted an air-temperature-sensing memory metal-spring (34), one end of which is secured (at 36) within the casing of the apparatus while its other end is secured to a first point (38) of a lever device (40) rotatably mounted (at 41) on the apparatus casing, said lever device being, in addition, acted upon, on the one hand, by a counterforce spring (42) secured between the apparatus casing and a second point (46) of the lever device, and, on the other hand, by a regulating wire (48) which extends between a third point (50) on the lever device (40) and one end of a return spring (52), the other end of which is secured (at 58) to the casing of the apparatus; and in that the regulating wire (48) has attached thereto control means (72,74) which are capable of acting, when the wire moves, on damper spindles (60,62) of dampers (28,30) which function to control the passage of co-ejected room air (R) through the apparatus either through one of the batteries (18 or 20, respectively) for cooling or heating and/or through an inlet duct (26), in which the room air does not pass through any of the batteries.

2. An arrangement according to Claim 1, characterized in that the memory metal-spring is a helical spring (34) in the form of a tension spring, which is fixed to the casing of the apparatus on the front side thereof facing the interior of the enclosed locality/room.

3. An arrangement according to Claim 1 or 2, for an apparatus (2) with an at least substantially parallelepipedic apparatus casing (4), characterized in that the memory metal-spring (34) and the counterforce spring (42) are arranged on a side of the apparatus casing facing the interior of the enclosed locality/room, in which side of the casing there are arranged air inlets (22 and 24, respectively) to the cooling and heating batteries and to the inlet duct (26), which can be closed by means of the dampers.

4. An arrangement according to any one of Claims 1-3, characterized in that the return spring (52) is a tension spring secured to one side wall of the apparatus casing, said spring being operative to ensure the return movement of the regulating wire (48) such as to return the respective damper (28 or 30).

5. An arrangement according to any one of the preceding claims, characterized in that the memory metal-spring (34) has been heat-treated in such a way that its memory storage interval for temperature-related changes in length is within a temperature range corresponding to the normal range of comfort ventilation, preferably the range 18-24°C.

6. An arrangement according to any one of the preceding claims, characterized in that the memory metal-spring (34) consists of a thin helically wound wire with a relatively large helix winding diameter.

7. An arrangement according to any one of the preceding claims, characterized in that the three points (38,46,50) on the lever device (40) which constitute the points of spring force engagement for the memory metal-spring (34), the counterforce spring (42) and the return spring (52), are so located in relation to one another and in relation to the pivot point (41) of the lever device as to bring about a substantially constant tensile force within the memory metal-spring irrespective of its temperature-related change of length.

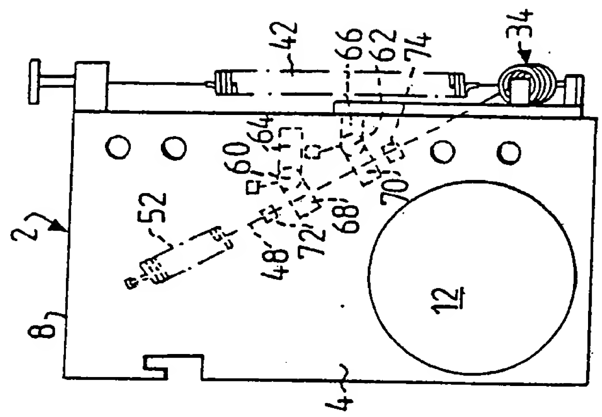

FIG. 2

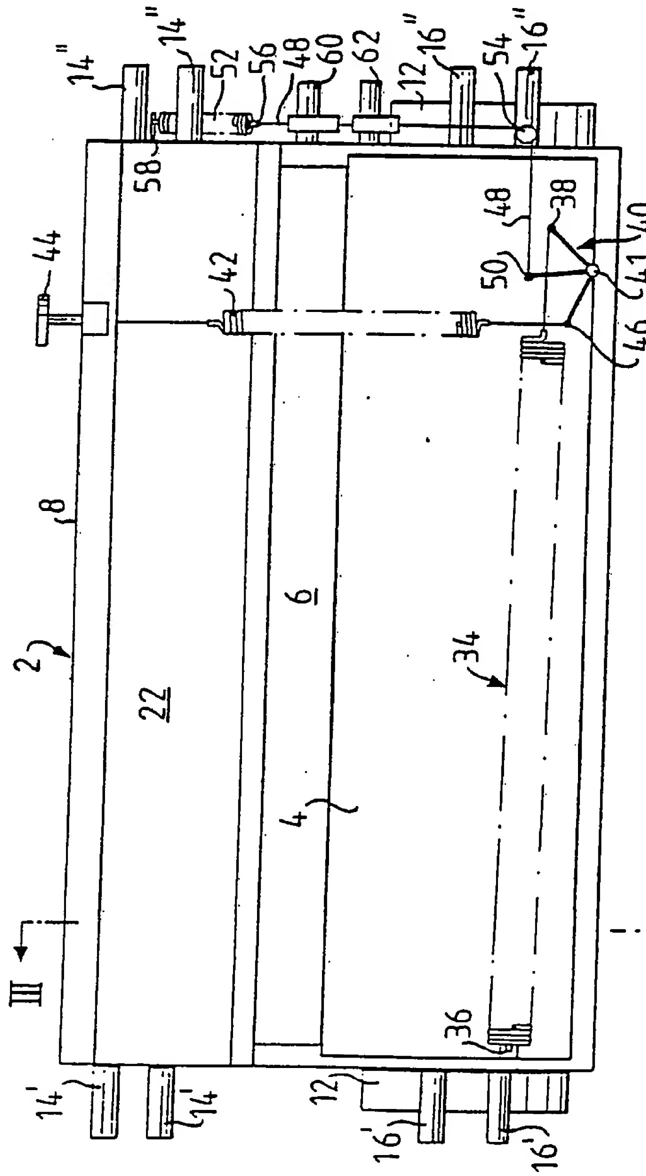

FIG.1

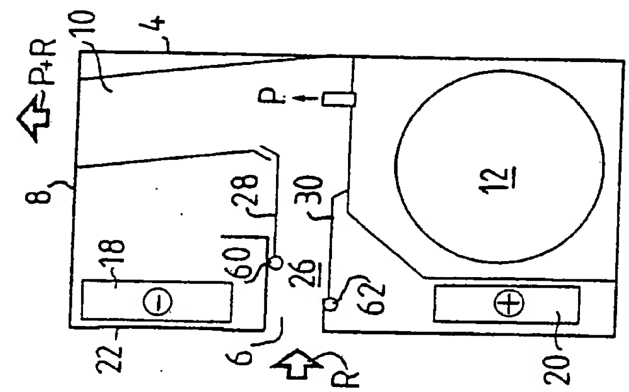

FIG.5

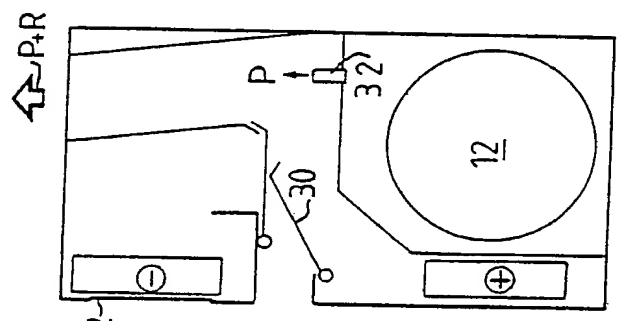

FIG.4

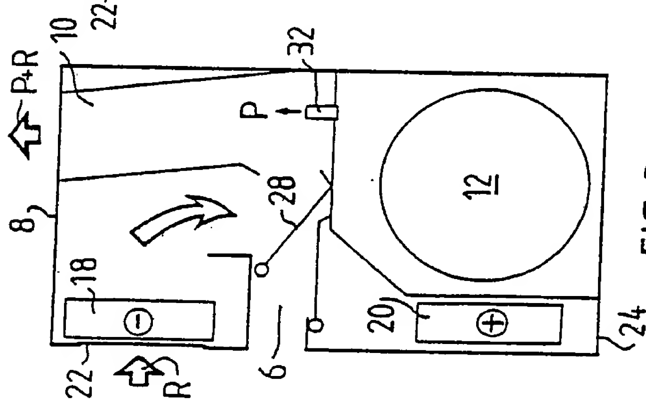

FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE89/00439

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

F 24 F 13/15

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	F 24 F 13/00, /08, /10, /14, /15, 11/053, 1/00, /02 3/04
US Cl	98:40, 38; 236:49, 1, 101; 165:16, 35, 123, 27, 101

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	DE, A1, 3 500 641 (MAICO ELEKTROAPPARATE-FABRIK GMBH) 10 July 1986	
A	Patent Abstract of Japan, Vol. 11, No 160, abstract of JP 61-291863, publ. 1986-12-22	
A	US, A, 4 541 326 (FUKUDA ET AL) 17 September 1985	

* Special categories of cited documents: [10]
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1989-10-31	1989 -11- 06
International Searching Authority	**Signature of Authorized Officer**
Swedish Patent Office	Anette Hall